

# APPARATUS FOR MAKING AN ANTENNA FOR WIRE TRANSPONDERS OF ELECTRICALLY CONDUCTIVE MATERIAL

This application is a divisional of U.S. patent application Ser. No. 11/883,159, filed Jul. 27, 2007 now U.S. Pat. No. 7,752,743, which is a national phase of PCT International Application No. PCT/IB2006/000156, filed 27 Jan. 2006. PCT/IB2006/000156 claims priority to IT Application No. MO2005A000017, filed 28 Jan. 2005. The entire contents of each of these applications are incorporated herein by reference in their entirety.

The present invention relates to a method and an apparatus for making antennas for RFID transponders, i.e. transponders for radiofrequency identifying devices.

RFID transponders consist of two essential parts, the so-called antenna, made as a coil in conductive material and an integrated circuit connected to the two ends of the antenna. Amongst the conductive materials with which the antenna can be constructed, copper wire covered with an insulating glaze is increasingly used today.

Apparatuses are known for making antennas in copper wire that deposit and fix the wire onto a substrate that is then used in the subsequent processes. Nevertheless, these apparatuses have a high cost/productivity ratio.

They are in fact constituted by a certain number of heads, normally six, each of which is supplied by a reel of glazed copper wire and deposits the wire on a substrate, normally in PVC. These heads move, drawing with the wire the pattern of the antenna and attaching the wire to the substrate by means of a vibrating hammer that follows the head in the movement thereof. The substrate either has to be of a material that softens with the heat generated by the vibrating hammer, retaining the wire, like PVC, or has to be previously coated with a product that performs the same function.

The heads that are thus constructed are relatively complex and heavy mechanisms, which means that both for economic questions and for questions of inertia to motion, the number of heads applicable to an apparatus is relatively small. This causes a very high cost/productivity ratio.

DE-A-3941318 discloses a method for making an integrated circuit on a ceramic substrate wherein a ceramic or similar substrate is positioned on support means movable along directions parallel to two axes of a Cartesian reference system under depositing means from which thick-film paste is ejected. The nozzle is raised and lowered in a direction parallel to a third axis of said Cartesian reference system.

In addition transponders RFID UHF are known, that is transponders operating at frequencies higher than 800 MHz (UHF), in which the antenna is a dipole antenna made of a lamina of electrically conductive material, for instance metallic material.

It is known in the state of art to make dipole antennas for RFID transponders starting from a lamina of electrically conductive material coupled with a flexible substrate; the profile of the dipole is cut on the lamina and, subsequently, the electrically conductive material outside the cut profile is removed, the electrically conductive material remaining on the flexible substrate constituting the dipole antenna.

Such a method requires the use of expensive apparatuses for making the cut of the profile of the antenna and, in addition, the electrically conductive material removed during production of the antenna is waste material, which implies a further increase of costs. Finally, the flexible substrate must consist of a material which is not damaged during the cutting operations of the profile of the antenna, which may involve considerable mechanical or thermal stresses for the substrate.

This need limit the materials which may be used for the flexible substrate and require a selection of said materials depending on the method used to cut the profile of the antenna.

Another known method provides for obtaining the dipole antenna by printing the antenna on a flexible substrate using electrically conductive inks.

Also this method involves comparatively high costs; in addition the antennas made of electrically conductive inks have an electric conductivity substantially lower than the conductivity of antennas made of laminas of electrically conductive material. The lower conductivity involves performances that are qualitatively lower than the performances of antennas made of laminas of electrically conductive material.

The present invention aims to provide an apparatus and a method for making antennas for RFID transponders that are relatively cheap and enable high productivity with moderate costs.

According to a first aspect of the present invention there is provided an apparatus for making an antenna for wire transponders of electrically conductive material, comprising at least one depositing device for depositing said wire on a substrate, said at least one depositing device and said substrate being movable with respect to one another, characterised in that it comprises a support element for said substrate, said support element being movable in directions parallel to the axes of a Cartesian reference system.

Owing to the provision of a substrate for the support movable according to the axes of a Cartesian reference system, it is possible to keep the at least one depositing device stationary with respect to said three axes. This allows the amount of masses in motion to be kept substantially constant, independently of the number and the mass of the depositing devices used, which makes possible a considerable increase in productivity with respect to the apparatuses known from the state of art.

The at least one depositing device may be made rotatable with respect to an axis perpendicular to the element supporting the substrate. This makes possible to optimize the deposition of the wire on the substrate.

According to another aspect of the present invention a method is provided for making an antenna for transponders, comprising depositing a wire in electrically conductive material on a substrate according to a preset pattern, fixing said wire to said support, characterised in that it comprises, before said depositing, applying to the outer surface of said wire an adhesive substance suitable for assuring the fixing of said wire on said substrate.

Owing to this aspect of the invention it is possible to fix in a simple, rapid and cheap manner the wire to the substrate, furthermore significantly simplifying the structure of the depositing means.

In fact, it no longer being necessary to perform hammering of the wire to ensure adhesion thereof to the substrate, the overall dimensions, weight and costs of the depositing means are significantly reduced.

According to a further aspect of the present invention a method is provided for making an antenna comprising providing a substrate intended to receive said antenna, providing at least one lamina, or wire, of electrically conductive material wound on a reel, unwinding said at least one lamina, or wire, from said reel, pressing said lamina, or wire, on a surface of said substrate by means of a pressing element, fixing said lamina, or wire, of electrically conductive material to said substrate, separating by means of a cutting device a portion of said lamina, or wire, fixed to said substrate from the remaining lamina, or wire, wound on said reel, said substrate and an